PACIFIC NORTH WEST

U. S. FOREST SERVICE

Research Note

FOREST AND RANGE EXPERIMENT STATION • U.S. DEPARTMENT OF AGRICULTURE • PORTLAND, OREGON

PNW-58 *July 1967*

AERIAL PHOTO INTERPRETATION OF UNDERSTORIES IN TWO OREGON OAK STANDS[1/]

by

H. Gyde Lund,[2/] *George R. Fahnestock,*[2/] *and John F. Wear*[3/]

Aerial color photography has shown promise for evaluating understory vegetation as a forest-fire fuel. Mapping understory vegetation from special aerial photography produced results reasonably similar to those obtained by an independent ground check. Differences in the methods used in the exploratory work prevented strict comparability, but agreement was close enough to suggest that further study would be fruitful. Perfection of photographic and interpretive techniques will improve ability to scout going fires and to map fuels for planning fire control systems. Information on visibility and trafficability in timber stands will be a side benefit.

In mid-July 1966, two hardwood stands in northwestern Oregon were photographed with Ektachrome Aero and Ektachrome Infrared Aero films[4/]

[1/] Sponsored by Advanced Research Projects Agency, Remote Area Conflict, ARPA Order 818. This Research Note is a condensation of the final progress report, dated December 30, 1966, on file at the Pacific Northwest Forest and Range Experiment Station, Portland, Oreg.

The authors gratefully acknowledge the aid of W. G. Morris in locating study areas and making the ground observations.

[2/] Research foresters, Pacific Northwest Forest and Range Experiment Station, Portland, Oreg.

[3/] Forester, Remote-Sensing Project, Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

[4/] Mention of trade names or products does not imply endorsement by the Forest Service.

at scales of 1:2,000 and 1:3,500. The photographs were taken with a Fairchild K-17 camera having a 12-inch focal length and 9- by 9-inch format. Most of the resulting photography was of excellent quality with near-maximum detail in crown shadows.

The dominant vegetation of the two stands was Oregon white oak averaging 60 feet tall, with scattered bigleaf maple, Pacific madrone, Oregon ash, and Douglas-fir. Crown closure was somewhat varied but averaged 92 percent on both areas. Understory vegetation varied rather widely in height and density. All of the woody understory was deciduous; the most important species were California hazel, Pacific serviceberry, Pacific dogwood, rose, trailing blackberry, and Pacific poisonoak. The most conspicuous herbaceous plant was western swordfern, an evergreen.

Topography consisted of dissected slopes, seldom exceeding 30 percent, between major valley bottoms and the gently rolling uplands. Total relief was about 300 feet. One area (Gray Farm) had a general southerly aspect; the other (Muddy Valley) faced east.

Gray Farm was used as a test site for selecting imagery and photo interpretation techniques to be applied on the Muddy Valley area. Photos were interpreted in the office and then taken to the field to compare with actual ground conditions. Ektachrome Aero photography at 1:3,500 was best for identifying and mapping the understory vegetation as to height and density (understory crown closure). Overstory shadows on the infrared photos were too dark to let the understory be seen adequately. Had the overstory been less dense or shorter, the infrared would have been more useful. The 1:2,000 photography had greater parallax displacement that was a hindrance to interpretation. A photo interpretation guide was developed for use with the Muddy Valley photography:

Photo characteristics	Indication
Overstory dense, uniform in spacing and color. Light-brown patches beneath canopy.	No brush beneath.
Overstory dense, uniform in spacing and color. Shadows deep; occasional green showing from ground.	Small scattered patches of brush.
Overstory with rough or feathery appearance. Shadows interrupted by various heights and shades of green to ground.	Tall and mixed brush beneath. The rougher the appearance, the taller and denser the brush.
Conglomeration of different shades of green. Heights uneven. No overstory present.	Brush of medium-to-heavy density and varied heights.

Examination of the Muddy Valley photos confirmed that Ektachrome Aero at 1:3,500 was better than the other film-scale combinations; therefore, this film and scale were used for the remainder of the study. "Pure" interpretation, i.e., without measurements, was tried first, then aerial reconnaissance in a light, fixed-wing aircraft, and finally photo interpretation with supplementary brush-height measurements.

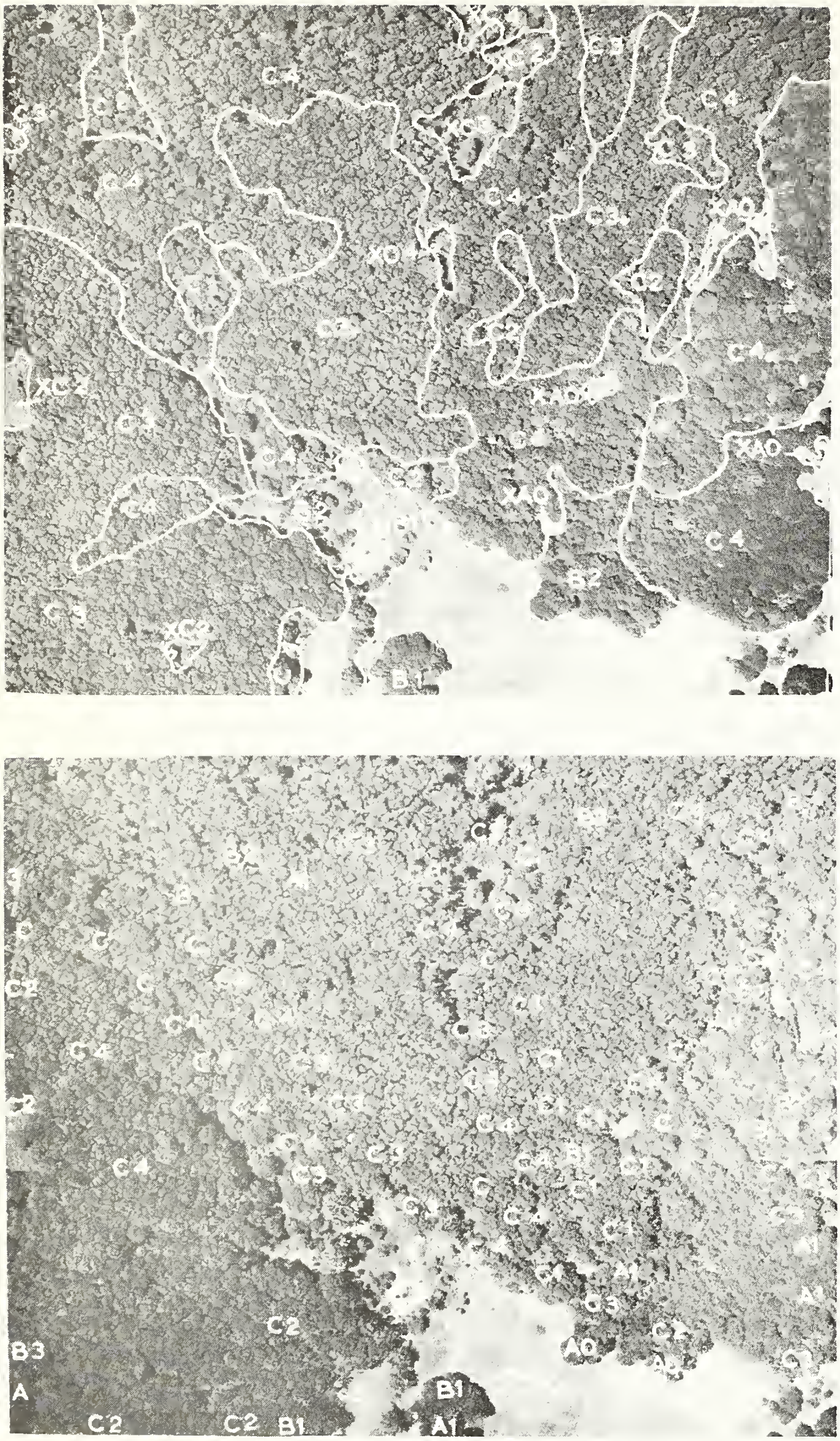
Pure interpretation developed a technique of stereo "stare" for looking past overstory crowns and concentrating on understory characteristics. Starting at an opening and working into the stand gave better results than trying to peer down through the crowns at any one point. Caution is necessary with this method to avoid "forcing" portions of the overstory to the ground. Such forcing can give a false impression of brush where there is none or of bare ground where bare branches occur. The main disadvantage of the pure interpretation was absence of any reliable estimate of brush height.

After the initial photography, aerial reconnaissance was tried to see if the area could be mapped from a fixed-wing aircraft and to evaluate heavily shaded areas that were impossible to interpret from the photos--north-facing slopes and areas under dense maple patches. The plane, even when flying at a speed of only 60 m.p.h. and at 100 feet above the canopy, moved too fast for practical mapping. Flying into the shadows, i.e., north to south, allowed more to be seen than did flying with or across the shadows. Some understory species could be recognized but could not be accurately located. As it was rather late in the year (September), shadows were long even at noon, and the north-facing slopes were still difficult to penetrate.

Photo interpretation with supplementary photo height measurements was finally used to produce a map of the understory by five height and three density classes (fig. 1, upper). This was compared with results of a reconnaissance on the ground.

The ground reconnaissance was made by a forester familiar with the vegetation and the study area but not with the aerial photographs. He did not make a map, but classified the understory at intervals along several irregular traverses, using the same categories as for photo interpretation (fig. 1, lower). In all, 89 points were rated and recorded on black-and-white prints in the field (a "point" actually was an area about one-half chain in diameter). However, accidents in handling the photos reduced the record to 68 points with both height and density, 19 with density only and 2 with height only.

Conclusive verification of photo interpretation by means of on-the-ground observations was not possible. Points rated on the ground might be obscured on the photographs or might be considered too small for separate mapping by the photo interpreter. Nevertheless, the mapped area ratings agreed reasonably well with the point ratings (table 1).



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Understory height (feet):

0 = 0 to 1
1 = 1 to 5
2 = 5 to 10
3 = 10 to 15
4 = 15+

Understory density (percent):

A = 0 to 33
B = 33 to 66
C = 66 to 100
X = Overstory absent

Figure 1.--Comparison of photo interpretation of Muddy Valley area with ground truth. *Upper*, type map drawn from photo interpretation supplemented by understory height measurements. *Lower*, independent point determination by observer on ground. Scale, 1:3,500.

Table 1.--Comparison of photographic and on-the-ground ratings in aerial photo interpretation of two Oregon oak stands

Information recorded	Total points	Ratings in agreement	
	Number	Number	Percent
Height and density	68	26	38
Density	87	65	75
Height	70	32	46

The greatest discrepancy resulted from a strong tendency to overestimate height on the aerial photos. Of 38 cases of disagreement, heights were overcalled in 32, undercalled in only 6. However, 61 percent of the discrepant estimates were only one height class above or below that determined on the ground. The tendency was to overestimate density also in comparison with ground observations. Of 22 cases of disagreement, 87 percent were overcalled, 13 percent undercalled, and 82 percent were within one density class.

The results of this exploratory study indicate that understory vegetation can be interpreted from natural-color aerial photography. Density was estimated reasonably well on the first attempt, but more work is needed in determining heights. Crown closure of about 90 percent was the limit; in denser canopies, openings large enough to give a good view of the understory are too scarce. Accuracy and reliability of interpretation should increase as the overstory density decreases. With the K-17 camera, a scale of 1:3,500 is the largest that can be interpreted comfortably and effectively.

A quick trial of 1:20,000 photography on Gray Farm revealed some advantages of the smaller scale for interpreting general understory features. Future research should determine whether a scale smaller than 1:3,500, with its added economies, will be suitable for detailed interpretation. A scale larger than 1:2,000 with either a high-speed camera or one with a smaller format would be needed to identify understory species. Low-altitude, fixed-base-length photography of small areas, using synchronized cameras mounted on a helicopter, may provide a means of double sampling when used in conjunction with small-scale

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coverage of the entire area. Film-exposure combinations should be tested to obtain optimum shadow penetration. Interpretation and ground truth techniques should be designed to compare the same points and areas.

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